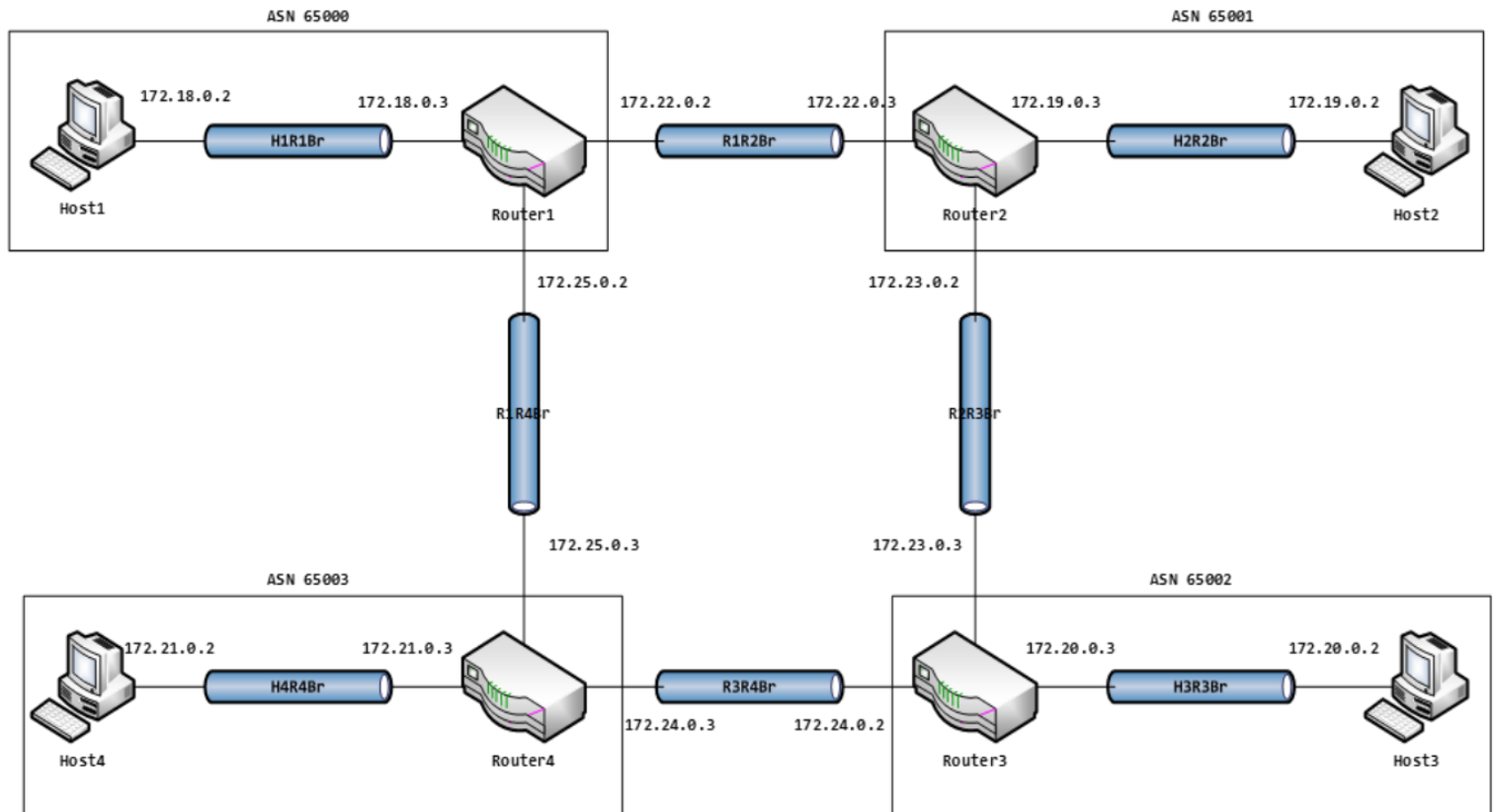


學號：L091197 姓名：郭紘安

## SDN-NFV Lab 6

### 1. Show topology with IP addresses, interfaces and ASNs



root@aa5545582540: /  
root@aa5545582540: /# route  
Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
default	172.18.0.1	0.0.0.0	UG	0	0	0	eth3
172.17.0.0	*	255.255.0.0	U	0	0	0	eth0
172.18.0.0	*	255.255.0.0	U	0	0	0	eth3
172.19.0.0	R2.R1R2Br	255.255.0.0	UG	0	0	0	eth4
172.20.0.0	R4.R1R4Br	255.255.0.0	UG	0	0	0	eth5
172.21.0.0	R4.R1R4Br	255.255.0.0	UG	0	0	0	eth5
172.22.0.0	*	255.255.0.0	U	0	0	0	eth4
172.25.0.0	*	255.255.0.0	U	0	0	0	eth5

root@aa5545582540: /#

root@807e7632441e: /  
root@807e7632441e: /# route  
Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
default	172.19.0.1	0.0.0.0	UG	0	0	0	eth7
172.17.0.0	*	255.255.0.0	U	0	0	0	eth0
172.18.0.0	R1.R1R2Br	255.255.0.0	UG	0	0	0	eth5
172.19.0.0	*	255.255.0.0	U	0	0	0	eth7
172.20.0.0	R3.R2R3Br	255.255.0.0	UG	0	0	0	eth6
172.21.0.0	R1.R1R2Br	255.255.0.0	UG	0	0	0	eth5
172.22.0.0	*	255.255.0.0	U	0	0	0	eth5
172.23.0.0	*	255.255.0.0	U	0	0	0	eth6

root@807e7632441e: /#

root@3a6e66e110b8: /  
root@3a6e66e110b8: /# route  
Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
default	172.21.0.1	0.0.0.0	UG	0	0	0	eth4
172.17.0.0	*	255.255.0.0	U	0	0	0	eth0
172.18.0.0	R1.R1R4Br	255.255.0.0	UG	0	0	0	eth0
172.19.0.0	R1.R1R4Br	255.255.0.0	UG	0	0	0	eth6
172.20.0.0	R3.R3R4Br	255.255.0.0	UG	0	0	0	eth5
172.21.0.0	*	255.255.0.0	U	0	0	0	eth4
172.24.0.0	*	255.255.0.0	U	0	0	0	eth5
172.25.0.0	*	255.255.0.0	U	0	0	0	eth6

root@3a6e66e110b8: /#

root@c501fec00373: /  
root@c501fec00373: /# route  
Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
default	172.20.0.1	0.0.0.0	UG	0	0	0	eth4
172.17.0.0	*	255.255.0.0	U	0	0	0	eth0
172.18.0.0	R4.R3R4Br	255.255.0.0	UG	0	0	0	eth6
172.19.0.0	R2.R2R3Br	255.255.0.0	UG	0	0	0	eth5
172.20.0.0	*	255.255.0.0	U	0	0	0	eth4
172.21.0.0	R4.R3R4Br	255.255.0.0	UG	0	0	0	eth6
172.23.0.0	*	255.255.0.0	U	0	0	0	eth5
172.24.0.0	*	255.255.0.0	U	0	0	0	eth6

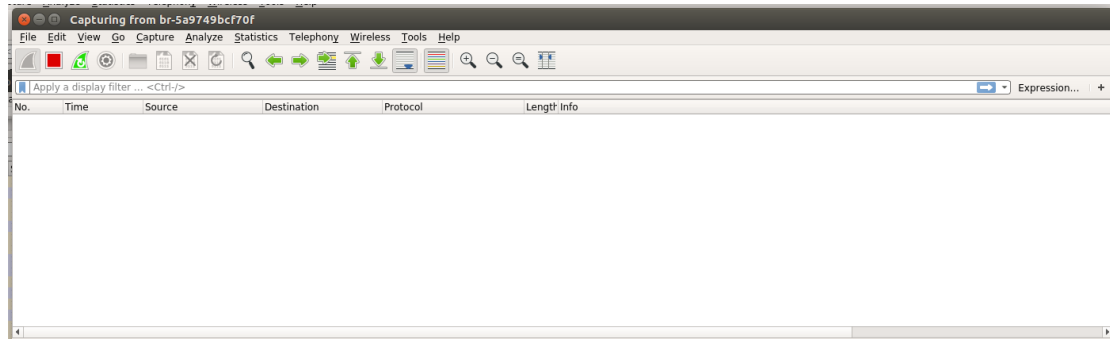
root@c501fec00373: /#

```
andy@ubuntu: ~  
andy@ubuntu:~$ sudo docker network ls  
NETWORK ID          NAME                DRIVER              SCOPE  
5a9749bcf70f        H1R1Br             bridge              local  
f3c3e9f3cba2        H2R2Br             bridge              local  
3c7f87bcf0a0        H3R3Br             bridge              local  
4588f6a37f22        H4R4Br             bridge              local  
61b557eeb557        R1R2Br             bridge              local  
d0a70700c404        R1R4Br             bridge              local  
72c0978412a8        R2R3Br             bridge              local  
f69aac13a26e        R3R4Br             bridge              local  
ea2874ce30dd        bridge             bridge              local  
f92a31d16f6d        host               host                local  
945c90cef2f4        none               null                local  
andy@ubuntu:~$
```

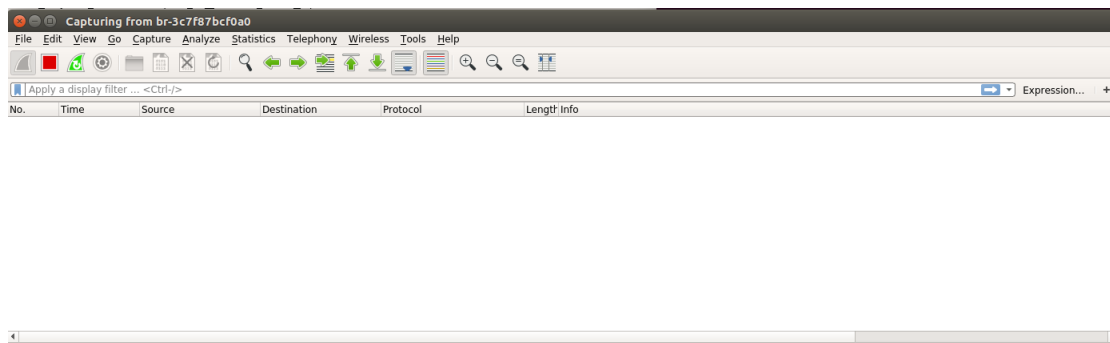
CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NA
MES						
5f28f38d6303	ubuntu:16.04	"/bin/bash"	2 days ago	Up 6 minutes		H2
3a6e66e110b8	ubuntu:16.04	"/bin/bash"	3 days ago	Up 6 minutes		R4
c501fec00373	ubuntu:16.04	"/bin/bash"	3 days ago	Up 6 minutes		R3
807e7632441e	ubuntu:16.04	"/bin/bash"	3 days ago	Up 6 minutes		R2
aa5545582540	ubuntu:16.04	"/bin/bash"	3 days ago	Up 6 minutes		R1
e5b0370ff907	ubuntu:16.04	"/bin/bash"	3 days ago	Up 6 minutes		H4
77ad2852f57f	ubuntu:16.04	"/bin/bash"	3 days ago	Up 6 minutes		H3
ea124fbd1a34	ubuntu:16.04	"/bin/bash"	3 days ago	Up 7 minutes		H1

## 2. Capture one BGP packet from wiresharkand show screenshots

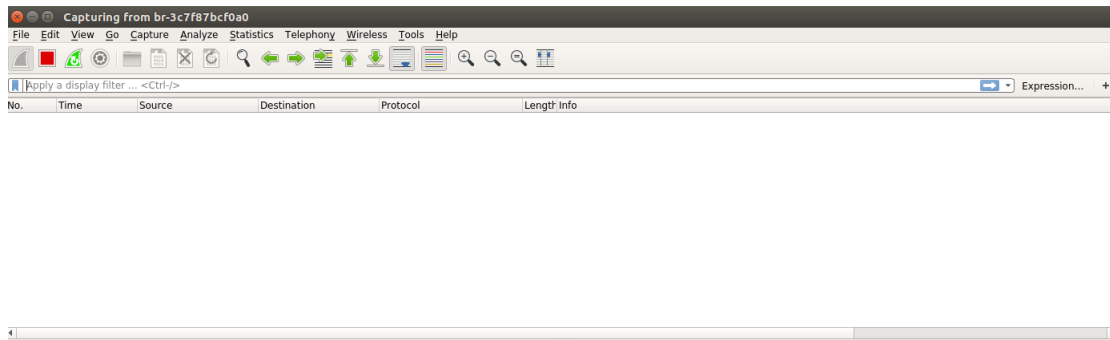
H1R1Br:



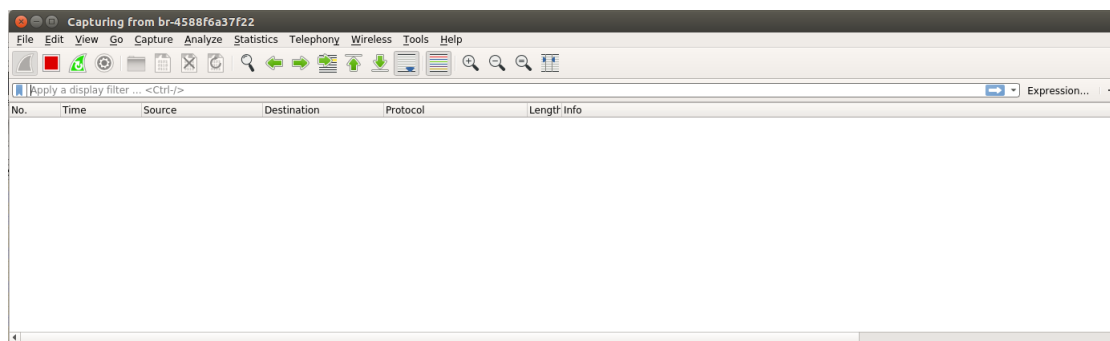
H2R2Br:



H3R3Br:



H4R4Br:



## R1R2Br:

Capturing from br-61b557eeb557						
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help						
Apply a display filter ... <Ctrl-/>						
No.	Time	Source	Destination	Protocol	Length Info	
1	0.000000000	172.22.0.2	172.22.0.3	BGP	85	KEEPALIVE Message
2	0.02739937	172.22.0.3	172.22.0.2	BGP	85	KEEPALIVE Message
3	0.027315093	172.22.0.2	172.22.0.3	TCP	66	179 → 53428 [ACK] Seq=20 Ack=20 Win=509 Len=0 TSval=3913188808 TSecr=1708902906
4	0.001394264	172.22.0.2	172.22.0.3	BGP	85	KEEPALIVE Message
5	0.027996699	172.22.0.3	172.22.0.2	BGP	85	KEEPALIVE Message
6	0.028065371	172.22.0.2	172.22.0.3	TCP	66	179 → 53428 [ACK] Seq=39 Ack=39 Win=509 Len=0 TSval=3913191808 TSecr=1708905906
7	0.002302697	172.22.0.2	172.22.0.3	BGP	85	KEEPALIVE Message
8	0.028487159	172.22.0.3	172.22.0.2	BGP	85	KEEPALIVE Message
9	0.028589184	172.22.0.2	172.22.0.3	TCP	66	179 → 53428 [ACK] Seq=58 Ack=58 Win=509 Len=0 TSval=3913194808 TSecr=1708908906
10	0.003287259	172.22.0.2	172.22.0.3	BGP	85	KEEPALIVE Message
11	0.02895196	172.22.0.3	172.22.0.2	BGP	85	KEEPALIVE Message
12	0.029137744	172.22.0.2	172.22.0.3	TCP	66	179 → 53428 [ACK] Seq=77 Ack=77 Win=509 Len=0 TSval=3913197807 TSecr=1708911905
13	0.004040687	172.22.0.2	172.22.0.3	BGP	85	KEEPALIVE Message
14	0.030219362	172.22.0.3	172.22.0.2	BGP	85	KEEPALIVE Message
15	0.030338559	172.22.0.2	172.22.0.3	TCP	66	179 → 53428 [ACK] Seq=96 Ack=96 Win=509 Len=0 TSval=3913200808 TSecr=1708914906
16	0.005438610	172.22.0.2	172.22.0.3	BGP	85	KEEPALIVE Message
17	0.031107018	172.22.0.3	172.22.0.2	BGP	85	KEEPALIVE Message
18	0.03197133	172.22.0.2	172.22.0.3	TCP	66	179 → 53428 [ACK] Seq=115 Ack=115 Win=509 Len=0 TSval=3913203808 TSecr=1708917906
19	0.006432545	172.22.0.2	172.22.0.3	BGP	85	KEEPALIVE Message

## R1R4Br:

Capturing from br-d0a70700c404						
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help						
Apply a display filter ... <Ctrl-/>						
No.	Time	Source	Destination	Protocol	Length Info	
4	0.709095154	172.25.0.2	172.25.0.3	BGP	85	KEEPALIVE Message
5	0.843752983	172.25.0.3	172.25.0.2	TCP	66	37490 → 179 [ACK] Seq=20 Ack=20 Win=501 Len=0 TSval=3765248228 TSecr=1464405883
6	0.808873739	172.25.0.3	172.25.0.2	BGP	85	KEEPALIVE Message
7	0.801841189	172.25.0.2	172.25.0.3	BGP	85	KEEPALIVE Message
8	0.801121730	172.25.0.3	172.25.0.2	TCP	66	37490 → 179 [ACK] Seq=39 Ack=39 Win=501 Len=0 TSval=3765251185 TSecr=1464408884
9	0.801418049	172.25.0.2	172.25.0.3	BGP	85	KEEPALIVE Message
10	0.801424385	172.25.0.2	172.25.0.3	BGP	85	KEEPALIVE Message
11	0.801508820	172.25.0.3	172.25.0.2	TCP	66	37490 → 179 [ACK] Seq=58 Ack=58 Win=501 Len=0 TSval=3765254185 TSecr=1464411884
12	0.843709484	172.25.0.2	172.25.0.3	TCP	66	179 → 37490 [ACK] Seq=58 Ack=58 Win=500 Len=0 TSval=1464411920 TSecr=3765254395
13	0.801722377	172.25.0.3	172.25.0.2	BGP	85	KEEPALIVE Message
14	0.801329990	172.25.0.2	172.25.0.3	TCP	66	179 → 37490 [ACK] Seq=58 Ack=77 Win=500 Len=0 TSval=1464414884 TSecr=3765257185
15	0.801807971	172.25.0.2	172.25.0.3	BGP	85	KEEPALIVE Message
16	0.802024322	172.25.0.3	172.25.0.2	TCP	66	37490 → 179 [ACK] Seq=77 Ack=77 Win=501 Len=0 TSval=3765257185 TSecr=1464414884
17	0.803099222	172.25.0.3	172.25.0.2	BGP	85	KEEPALIVE Message
18	0.803357624	172.25.0.2	172.25.0.3	BGP	85	KEEPALIVE Message
19	0.803440130	172.25.0.3	172.25.0.2	TCP	66	37490 → 179 [ACK] Seq=96 Ack=96 Win=501 Len=0 TSval=3765260186 TSecr=1464417885
20	0.804311760	172.25.0.3	172.25.0.2	BGP	85	KEEPALIVE Message
21	0.804637070	172.25.0.2	172.25.0.3	BGP	85	KEEPALIVE Message
22	0.804690771	172.25.0.3	172.25.0.2	TCP	66	37490 → 179 [ACK] Seq=115 Ack=115 Win=501 Len=0 TSval=3765263187 TSecr=1464420886

## R2R3Br:

Capturing from br-72c0978412a8						
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help						
Apply a display filter ... <Ctrl-/>						
No.	Time	Source	Destination	Protocol	Length Info	
1	0.000000000	172.23.0.2	172.23.0.3	BGP	85	KEEPALIVE Message
2	0.000043191	172.23.0.3	172.23.0.2	BGP	85	KEEPALIVE Message
3	0.000109045	172.23.0.3	172.23.0.2	TCP	66	44480 → 179 [ACK] Seq=20 Ack=20 Win=501 Len=0 TSval=3721928756 TSecr=963541472
4	0.043203398	172.23.0.2	172.23.0.3	TCP	66	179 → 44480 [ACK] Seq=20 Ack=20 Win=509 Len=0 TSval=963541516 TSecr=3721928756
5	0.000015641	172.23.0.2	172.23.0.3	BGP	85	KEEPALIVE Message
6	0.000775925	172.23.0.3	172.23.0.2	TCP	66	44480 → 179 [ACK] Seq=20 Ack=39 Win=501 Len=0 TSval=3721931756 TSecr=963544473
7	0.001001179	172.23.0.2	172.23.0.3	BGP	85	KEEPALIVE Message
8	0.001074559	172.23.0.2	172.23.0.3	TCP	66	179 → 44480 [ACK] Seq=39 Ack=39 Win=509 Len=0 TSval=963544473 TSecr=3721931756
9	5.845266619	fe80::42:85ff::fe47::1b	fe80::1b	MDNS	180	Standard query 0x0000 PTR _tcp._tcp.local, "qm" question PTR _afpovertcp._tcp.local, "qm" question PTR _sm
10	5.845319909	172.23.0.1	224.0.0.251	MDNS	180	Standard query 0x0000 PTR _tcp._tcp.local, "qm" question PTR _afpovertcp._tcp.local, "qm" question PTR _sm
11	6.002322764	172.23.0.3	172.23.0.2	BGP	85	KEEPALIVE Message
12	6.002331743	172.23.0.2	172.23.0.3	BGP	85	KEEPALIVE Message
13	6.002403361	172.23.0.2	172.23.0.3	TCP	66	179 → 44480 [ACK] Seq=58 Ack=58 Win=509 Len=0 TSval=963547474 TSecr=3721934757
14	6.002602918	172.23.0.3	172.23.0.2	TCP	66	44480 → 179 [ACK] Seq=58 Ack=58 Win=501 Len=0 TSval=3721934798 TSecr=963547474
15	9.002601904	172.23.0.2	172.23.0.3	BGP	85	KEEPALIVE Message
16	9.002704688	172.23.0.3	172.23.0.2	TCP	66	44480 → 179 [ACK] Seq=58 Ack=77 Win=501 Len=0 TSval=3721937757 TSecr=963550474
17	9.002920869	172.23.0.3	172.23.0.2	BGP	85	KEEPALIVE Message
18	9.002941388	172.23.0.2	172.23.0.3	TCP	66	179 → 44480 [ACK] Seq=77 Ack=77 Win=509 Len=0 TSval=963550474 TSecr=3721937757
19	12.003077708	172.23.0.2	172.23.0.3	BGP	85	KEEPALIVE Message

## R3R4Br:

Capturing from br-f69aac13a26e						
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help						
Apply a display filter ... <Ctrl-/>						
No.	Time	Source	Destination	Protocol	Length Info	
11	9.002668641	172.24.0.2	172.24.0.3	BGP	85	KEEPALIVE Message
12	9.002898193	172.24.0.3	172.24.0.2	TCP	66	39458 → 179 [ACK] Seq=77 Ack=77 Win=501 Len=0 TSval=3358552766 TSecr=2554985244
13	9.046708964	172.24.0.2	172.24.0.3	TCP	66	179 → 39458 [ACK] Seq=77 Ack=77 Win=509 Len=0 TSval=2554985288 TSecr=3358552766
14	12.003026570	172.24.0.3	172.24.0.2	BGP	85	KEEPALIVE Message
15	12.003378339	172.24.0.2	172.24.0.3	TCP	66	179 → 39458 [ACK] Seq=77 Ack=96 Win=509 Len=0 TSval=2554988245 TSecr=3358555767
16	12.003555222	172.24.0.2	172.24.0.3	BGP	85	KEEPALIVE Message
17	12.003572189	172.24.0.3	172.24.0.2	TCP	66	39458 → 179 [ACK] Seq=96 Ack=96 Win=501 Len=0 TSval=3358555767 TSecr=2554988245
18	15.004123961	172.24.0.3	172.24.0.2	BGP	85	KEEPALIVE Message
19	15.004848268	172.24.0.2	172.24.0.3	BGP	85	KEEPALIVE Message
20	15.004881314	172.24.0.3	172.24.0.2	TCP	66	39458 → 179 [ACK] Seq=115 Ack=115 Win=501 Len=0 TSval=3358558768 TSecr=2554991246
21	18.004230405	172.24.0.3	172.24.0.2	BGP	85	KEEPALIVE Message
22	18.005361621	172.24.0.2	172.24.0.3	BGP	85	KEEPALIVE Message
23	18.005828739	172.24.0.3	172.24.0.2	TCP	66	39458 → 179 [ACK] Seq=134 Ack=134 Win=501 Len=0 TSval=3358561769 TSecr=2554994247
24	21.004755478	172.24.0.3	172.24.0.2	BGP	85	KEEPALIVE Message
25	21.006244142	172.24.0.2	172.24.0.3	BGP	85	KEEPALIVE Message
26	21.006329550	172.24.0.3	172.24.0.2	TCP	66	39458 → 179 [ACK] Seq=153 Ack=153 Win=501 Len=0 TSval=3358564770 TSecr=2554997248
27	24.005309510	172.24.0.3	172.24.0.2	BGP	85	KEEPALIVE Message
28	24.006490951	172.24.0.2	172.24.0.3	BGP	85	KEEPALIVE Message
29	24.006574884	172.24.0.3	172.24.0.2	TCP	66	39458 → 179 [ACK] Seq=172 Ack=172 Win=501 Len=0 TSval=3358567770 TSecr=2555000248

### 3. Telnet zebra and bgpd daemons of each route and show route screenshots

#### zebra:

R1	R2
<pre>root@aa5545582540:/ root@aa5545582540:/# telnet localhost 2601 Trying 127.0.0.1... Connected to localhost. Escape character is '^J'.  Hello, this is Quagga (version 0.99.24.1). Copyright 1996-2005 Kunihiko Ishiguro, et al.  User Access Verification  Password: R1zebra&gt; show ip route bgp Codes: K - kernel route, C - connected, S - static, R - RIP,         O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,         &gt; - selected route, * - FIB route  B&gt;* 172.19.0.0/16 [20/0] via 172.22.0.3, eth4, 00:02:31 B&gt;* 172.20.0.0/16 [20/0] via 172.25.0.3, eth5, 00:02:25 B&gt;* 172.21.0.0/16 [20/0] via 172.25.0.3, eth5, 00:02:40 R1zebra&gt;</pre>	<pre>root@80767632441c:/ root@80767632441c:/# telnet localhost 2601 Trying 127.0.0.1... Connected to localhost. Escape character is '^J'.  Hello, this is Quagga (version 0.99.24.1). Copyright 1996-2005 Kunihiko Ishiguro, et al.  User Access Verification  Password: R2zebra&gt; show ip route bgp Codes: K - kernel route, C - connected, S - static, R - RIP,         O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,         &gt; - selected route, * - FIB route  B&gt;* 172.18.0.0/16 [20/0] via 172.22.0.2, eth5, 00:02:33 B&gt;* 172.20.0.0/16 [20/0] via 172.23.0.3, eth6, 00:02:26 B&gt;* 172.21.0.0/16 [20/0] via 172.22.0.2, eth5, 00:02:33 R2zebra&gt;</pre>
R4	R3
<pre>root@3af6e6e110b8:/ root@3af6e6e110b8:/# telnet localhost 2601 Trying 127.0.0.1... Connected to localhost. Escape character is '^J'.  Hello, this is Quagga (version 0.99.24.1). Copyright 1996-2005 Kunihiko Ishiguro, et al.  User Access Verification  Password: R4zebra&gt; show ip route bgp Codes: K - kernel route, C - connected, S - static, R - RIP,         O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,         &gt; - selected route, * - FIB route  B&gt;* 172.18.0.0/16 [20/0] via 172.25.0.2, eth6, 00:02:45 B&gt;* 172.19.0.0/16 [20/0] via 172.25.0.2, eth6, 00:02:39 B&gt;* 172.20.0.0/16 [20/0] via 172.24.0.2, eth5, 00:02:32 R4zebra&gt;</pre>	<pre>root@c501fec00373:/ root@c501fec00373:/# telnet localhost 2601 Trying 127.0.0.1... Connected to localhost. Escape character is '^J'.  Hello, this is Quagga (version 0.99.24.1). Copyright 1996-2005 Kunihiko Ishiguro, et al.  User Access Verification  Password: R3zebra&gt; show ip route bgp Codes: K - kernel route, C - connected, S - static, R - RIP,         O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,         &gt; - selected route, * - FIB route  B&gt;* 172.18.0.0/16 [20/0] via 172.24.0.3, eth6, 00:02:31 B&gt;* 172.19.0.0/16 [20/0] via 172.23.0.2, eth5, 00:02:28 B&gt;* 172.21.0.0/16 [20/0] via 172.24.0.3, eth6, 00:02:31 R3zebra&gt;</pre>

#### bgpd:

R1	R2
<pre>root@aa5545582540:/ root@aa5545582540:/# telnet localhost 2605 Trying 127.0.0.1... Connected to localhost. Escape character is '^J'.  Hello, this is Quagga (version 0.99.24.1). Copyright 1996-2005 Kunihiko Ishiguro, et al.  User Access Verification  Password: R1bgp&gt; show ip bgp summary BGP router identifier 172.25.0.2, local AS number 65000 RIB entries 7, using 784 bytes of memory Peers 2, using 9136 bytes of memory  Neighbor      V      AS  MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd 172.22.0.3    4 65001    82    86      0    0 0 00:03:56      2 172.25.0.3    4 65003    88    87      0    0 0 00:04:06      2  Total number of neighbors 2 R1bgp&gt;</pre>	<pre>root@80767632441c:/ root@80767632441c:/# telnet localhost 2605 Trying 127.0.0.1... Connected to localhost. Escape character is '^J'.  Hello, this is Quagga (version 0.99.24.1). Copyright 1996-2005 Kunihiko Ishiguro, et al.  User Access Verification  Password: R2bgp&gt; show ip bgp summary BGP router identifier 172.23.0.2, local AS number 65001 RIB entries 7, using 784 bytes of memory Peers 2, using 9136 bytes of memory  Neighbor      V      AS  MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd 172.22.0.2    4 65000    85    85      0    0 0 00:03:59      3 172.23.0.3    4 65002    82    86      0    0 0 00:03:53      3  Total number of neighbors 2 R2bgp&gt;</pre>
R4	R3
<pre>root@3af6e6e110b8:/ root@3af6e6e110b8:/# telnet localhost 2605 Trying 127.0.0.1... Connected to localhost. Escape character is '^J'.  Hello, this is Quagga (version 0.99.24.1). Copyright 1996-2005 Kunihiko Ishiguro, et al.  User Access Verification  Password: R4bgp&gt; show ip bgp summary BGP router identifier 172.24.0.3, local AS number 65003 RIB entries 7, using 784 bytes of memory Peers 2, using 9136 bytes of memory  Neighbor      V      AS  MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd 172.24.0.2    4 65002    95    95      0    0 0 00:03:54      2 172.25.0.2    4 65000    89    94      0    0 0 00:04:07      2  Total number of neighbors 2 R4bgp&gt;</pre>	<pre>root@c501fec00373:/ root@c501fec00373:/# telnet localhost 2605 Trying 127.0.0.1... Connected to localhost. Escape character is '^J'.  Hello, this is Quagga (version 0.99.24.1). Copyright 1996-2005 Kunihiko Ishiguro, et al.  User Access Verification  Password: R3bgp&gt; show ip bgp summary BGP router identifier 172.24.0.2, local AS number 65002 RIB entries 7, using 784 bytes of memory Peers 2, using 9136 bytes of memory  Neighbor      V      AS  MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd 172.23.0.2    4 65001    84    85      0    0 0 00:03:55      3 172.24.0.3    4 65003    85    85      0    0 0 00:03:58      3  Total number of neighbors 2 R3bgp&gt;</pre>

#### 4. Write down what you have learned or solved

一開始透過一個小範例學到如何使用 docker 來建立設定使用 host、router 和 bridge，以及透過 terminal 設定 host 的 default gateway，並透過 terminal 設定 router 的 Quagga 和 Zebra，在最後透過實作一個拓樸來加深我對 docker 的認知以及使用方式。